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Exposure to silver nanospheres leads to altered respiratory mechanics and delayed immune response in an in Vivo murine model

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Abstract

© 2018 Botelho, Leo, Massa, Sarkar, Tetley, Chung, Chen, Ryan, Porter, Atochina-Vasserman, Zhang, Schwander and Gow. Here we examine the organ level toxicology of both carbon black (CB) and silver nanoparticles (AgNP). We aim to determine metal-specific effects to respiratory function, inflammation and potential interactions with lung lining fluid (LLF). C57Bl6/J male mice were intratracheally instilled with saline (control), low (0.05 μg/g) or high (0.5 μg/g) doses of either AgNP or CB 15 nm nanospheres. Lung histology, cytology, surfactant composition and function, inflammatory gene expression, and pulmonary function were measured at 1, 3, and 7 days post-exposure. Acutely, high dose CB resulted in an inflammatory response, increased neutrophilia and cytokine production, without alteration in surfactant composition or respiratory mechanics. Low dose CB had no effect. Neither low nor high dose AgNPs resulted in an acute inflammatory response, but there was an increase in work of breathing. Three days post-exposure with CB, a persistent neutrophilia was noted. High dose AgNP resulted in an elevated number of macrophages and invasion of lymphocytes. Additionally, AgNP treated mice displayed increased expression of IL1B, IL6, CCL2, and IL10. However, there were no significant changes in respiratory mechanics. At day 7, inflammation had resolved in AgNP-treated mice, but tissue stiffness and resistance were significantly decreased, which was accompanied by an increase in surfactant protein D (SP-D) content. These data demonstrate that the presence of metal alters the response of the lung to nanoparticle exposure. AgNP-surfactant interactions may alter respiratory function and result in a delayed immune response, potentially due to modified airway epithelial cell function.

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Keywords

Inflammation, Lung, Nanoparticles, Pulmonary function, Silver nanoparticles, Surfactant

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